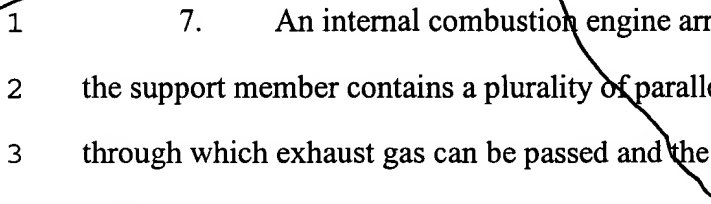


## I CLAIM:

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1. An internal combustion engine arrangement comprising:  
 a spark-ignited internal combustion engine;  
 an exhaust line receiving exhaust gas from the internal combustion engine;  
 an oxide gas absorber in the exhaust line including a support member; and an  
 absorption layer on a surface of the support member having an enlarged surface area  
 accessible to exhaust gas flowing through the exhaust line for reversible absorption at  
 least one nitrogen oxide (NO<sub>x</sub>) and/or at least one oxide of sulfur (SO<sub>x</sub>); and,  
 a control unit for controlling the temperature of the absorption layer by adjusting  
 parameters of the exhaust gas so that the absorption layer can be heated to a temperature  
 at which the layer is regenerated by desorbing absorbed NO<sub>x</sub> or SO<sub>x</sub>.
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- ~~2. An internal combustion engine arrangement according to claim 1 wherein  
 the support member is a metal support member.~~
- 1  
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3. An internal combustion engine arrangement according to claim 2 wherein  
 the metal support member is a metal foil.
- 1  
2
- ~~4. An internal combustion engine arrangement according to claim 2 wherein  
 the metal support member is heatable by application of an electric current.~~
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5. An internal combustion engine arrangement according to claim 2 wherein  
 the metal support member has a wall thickness  $\leq 0.1$  mm.

1           6.       An internal combustion engine arrangement according to claim 5 wherein  
2       the metal support member has a wall thickness  $\leq 0.06$  mm.

 1           7.       An internal combustion engine arrangement according to claim 1 wherein  
2       the support member contains a plurality of parallel passages having a closed cross-section  
3       through which exhaust gas can be passed and the absorption layer is on the inside surface  
4       of the passages.

1           8.       An internal combustion engine arrangement according to claim 7 wherein  
2       at least some of the passages have a structure causing turbulent gas flow at least over a  
3       portion of the passage.

1           9.       An internal combustion engine arrangement according to claim 8 wherein  
2       the structure causing the turbulent gas flow is at least one of: (a) a variation in cross-  
3       section; (b) a corrugation; and (c) a twisting or curvature of the passages.

1           10.      An internal combustion engine arrangement according to claim 7 wherein  
2       the oxide gas absorber is subdivided into a plurality of segments.

1           11.      An internal combustion engine arrangement according to claim 10 wherein  
2       the plurality of segments have at least one of: (a) different lengths; (b) different passage  
3       cross-sections; (c) different numbers of passages; and (d) spacing between segments of at  
4       least 50 cm.

12. An internal combustion engine arrangement according to claim 1 wherein  
the enlarged surface area provides an area of at least 20 m<sup>2</sup> accessible to the exhaust gas  
per gram of the absorption layer.

13. An internal combustion engine arrangement according to claim 12 wherein  
the enlarged surface area provides an area of at least 40 m<sup>2</sup> accessible to the exhaust gas  
per gram of the absorption layer.

14. An internal combustion engine arrangement according to claim 13 wherein  
the enlarged surface area provides an area of at least 100 m<sup>2</sup> accessible to the exhaust gas  
per gram of the absorption layer.

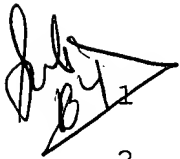
15. An internal combustion engine arrangement according to claim 1 wherein  
the absorption layer contains an aluminum oxide.

16. An internal combustion engine arrangement according to claim 15 wherein  
the absorption layer contains gamma aluminum oxide.

17. An internal combustion engine arrangement to claim 1 wherein the  
absorption layer contains an element selected from the group consisting of alkali metals,  
alkaline-earth metals, rare earths, lanthanum, titanium, copper and manganese..


18. An internal combustion engine arrangement according to claim 1 wherein  
the absorption layer contains at least one of the elements barium, sodium and potassium.

1           19.     An internal combustion engine arrangement according to claim 1 wherein  
2     the absorption layer absorbs NO<sub>x</sub> and/or SO<sub>x</sub> from an exhaust gas with an excess of  
3     oxygen during lean operation of the internal combustion engine.

 1           20.     An internal combustion engine arrangement according to claim 1 wherein  
2     the absorption layer releases NO<sub>x</sub> and/or SO<sub>x</sub> in a reducing atmosphere and/or at low  
3     oxygen concentration in the exhaust gas.

1           21.     An internal combustion engine arrangement according to either of claim  
2     19 or claim 20 including an oxygen concentration determining means for determining a  
3     value representing the oxygen concentration in the exhaust gas and supplying a signal  
4     representing the oxygen concentration as an input signal to the control unit, and wherein  
5     the control unit uses the oxygen concentration signal to control charging or discharging of  
6     the absorber.

1           22.     An internal combustion engine arrangement according to claim 1 wherein  
2     the absorption layer desorbs NO<sub>x</sub> and SO<sub>x</sub> at an elevated temperature.

 1           23.     An internal combustion engine arrangement according to claim 22  
2     including a temperature determining means for determining a value representing the  
3     temperature of at least one of: (a) the exhaust gas; (b) the absorption layer; and  
4     (c) the support member; and supplying a signal corresponding to that value as an input  
5     signal to the control unit for control of charging or discharging of the absorber.

1           24.    An internal combustion engine arrangement according to claim 23  
2    wherein the control unit receives signals representing both the oxygen concentration in  
3    the exhaust gas and the temperature of the exhaust gas as input signals.

1           25.    An internal combustion engine arrangement according to claim 1 wherein  
2    the support member is a ceramic member and the absorption layer has a thickness of at  
3    least 50 microns.

1           26.    An internal combustion engine arrangement according to claim 1 wherein  
2    the support member is a metal member and the absorption layer has a thickness of at least  
3    25 microns.

4           27.    An internal combustion engine arrangement according to claim 1 wherein  
5    the absorption layer is applied as a wash coat.

1           28.    An internal combustion engine arrangement according to claim 1 wherein  
2    the absorption layer contains at least one precious metal.

1           29.    An internal combustion engine arrangement according to claim 28 wherein  
2    the absorption containing the precious metal constitutes an oxidation catalyst or a three-  
3    way catalyst.

1           30.    An internal combustion engine arrangement according to claim 1 wherein  
2    the absorption layer accessible to the exhaust gas has a pore volume of at least 0.2 cm<sup>3</sup>/g.

1           31.     An internal combustion engine arrangement according to claim 1  
2 including an oxidation catalyst separate from the oxide gas absorber.

1           32.     An internal combustion engine arrangement according to claim 31 wherein  
2 the oxidation catalyst is a three-way catalyst.

1           33.     A method for removing at least one nitrogen oxide ( $\text{NO}_x$ ) from the exhaust  
2 gas of an internal combustion engine, comprising the steps of:

3           (a) operating an internal combustion engine to produce an exhaust gas flow  
4 containing oxygen;

5           (b) passing exhaust gas containing oxygen over an absorber containing an  
6 absorbing layer on a surface of a support member;

7           (c) storing the  $\text{NO}_x$  in the absorbing layer;

8           (d) heating the absorbing layer to a predetermined temperature during the  
9 operation of the engine;

10          (e) producing an exhaust gas which is poor in oxygen or an exhaust gas having a  
11 stoichiometric excess of a reducing agent;

12          (f) desorbing the  $\text{NO}_x$  from the absorbing layer and reducing the  $\text{NO}_x$  in the  
13 exhaust gas which is poor in oxygen has a stoichiometric excess of reducing agent while  
14 the absorbing layer is a temperature equal to or above the predetermined temperature;

15          (g) again producing an exhaust gas containing oxygen;

16          (h) terminating heating of the absorbing layer to the predetermined temperature;

17          and

18          (j) repeating steps (c) through (h).

1           34.    A method according to claim 33 wherein the step of heating the absorbing  
2 layer is carried out by at least one of: (a) injecting fuel into the exhaust gas and catalytic  
3 combustion thereof, (b) varying the operating conditions of the internal combustion  
4 engine, (c) electrical heating of the absorbing layer and (d) using a burner to heat the  
5 exhaust gas.

1           35.    A method according to claim 33 wherein, before the step of heating the  
2 absorbing layer at least to a predetermined temperature during operation of the internal  
3 combustion engine, a step of determining whether a temperature value representing the  
4 temperature of the absorbing layer is at or above the predetermined temperature is carried  
5 out and, if it is determined that the temperature value representing the temperature of the  
6 absorbing layer is at or above the predetermined temperature, steps (d) and (b) are  
7 omitted.

1           36.    A method according to any one of claims 33-35 wherein the support  
2 member is a metal support member.

1           37.    A method according to any one of claims 33-35 wherein at least one oxide  
2 of sulfur ( $\text{SO}_x$ ) is also stored and desorbed by the absorbent layer.

1           38.    A method according to any one of claims 33-35 wherein the desorption  
2 from the absorber layer is carried out at periodic intervals.

1           39.    A method according to any one of claims 33-35 wherein the desorption  
2 from the absorbent layer is carried out depending on the amount of gas stored in the  
3 absorbent layer.

1           40.     A method according to any one of claims 33- 35 wherein the absorbent  
2     layer contains gamma-aluminum oxide and at least one element in the group consisting of  
3     alkali metals, alkaline-earth metals, rare earths and lanthanum.

1           41.     A method according to any one of claims 33-35 wherein the exhaust gas is  
2     passed over the absorbent layer with turbulence.

1           42.     A method according to any one of claims 33-35 wherein the support  
2     member has a plurality of parallel passages..

1           43.     A method according to claim 42 wherein the exhaust gas is passed over a  
2     plurality of support members containing the gas absorbing layer and having at least one  
3     of: (a) different numbers of passages; (b) passages of different flow diameters; and (c)  
4     spacings between the support members of at least 50 cm.

1           44.     A method according to claim 42 wherein the support member has a  
2     plurality of twisted or curved passages.